PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

ENVIRONMENTAL WATER AND RESOURCES

06/2000

DESIGN MANUAL FOR CLEAN COAL BY-PRODUCT MANAGEMENT

Description

Many utility planners and state-level regulators are not aware of the changes ahead in coal technology as new coal combustion technologies are commercialized. This design manual is a source book for information on managing the by-products from new clean coal technologies. These by-products are significantly different from conventional coal combustion by-products, and best management practices will vary for the new materials. This design manual brings together information on material characteristics, site selection, facility design, permitting, operations, and monitoring in a single volume to help focus the information gathering required to implement the new technologies.

The manual is based both on literature sources and on a comprehensive field study. The field study examines the performance of by-products from three lime-based dry SO_x control technologies: lime injection (LIMB); circulating fluidized bed combustion (CFBC); and bubbling fluidized bed combustion (BFBC).

The disposal environments at the test sites range from semi-arid conditions typical of the west to wet temperate conditions with shallow groundwater typical of many sites in the eastern United States. By-products were placed in minimally engineered 350- to 800-yd^3 test cells to simulate worst-case disposal conditions and facilitate weathering within a reasonable period of time. Comprehensive data on the structural properties of the ash, their leaching behavior, and their impact on the surrounding environment were collected from each site over a three- to five-year time period.

The three by-products studied in depth are all generated by lime-based dry SO_x control processes. The residual lime content of these by-products makes them reactive when exposed to water, and pozzolanic reactions can cement the materials into a coherent mass.

The field study indicates that under humid conditions the initial cementation of lime and sulfate-rich by-products quickly weathers to a soil-like consistency. Cracking and heaving can take place in materials that are not fully hydrated before compaction. Addition of Class F fly ash can produce a more stable, durable, and impermeable cement, improving disposal characteristics. Under semi-arid conditions, the initial cementation remains stable over much longer time periods. In most western sites, minimal engineering control may be needed to ensure environmental performance requirements.

Even in cases where significant amounts of leachate are generated from LIMB or FBC by-products, the environmental effects are expected to be limited. The mobility of most is limited by the high pH of the leachate, and other metals are bound in the solid phase by hydration reactions. Concentrations of common salts may be high in initial leachate, but decline rapidly after the first flush.

PRIMARY PROJECT PARTNER

Radian International
Austin, TX

MAIN SITE

Tri-States Generation and Transmission Association
Nucla, CO
Ohio Edison
Lorain, OH
Freeman United Coal Mining Company
Canton, IL

TOTAL ESTIMATED COST

$5,230,000

COST SHARING

DOE	$4,810,000
Non-DOE	$ 420,000

NETL

Design Manual for Clean Coal By-Product Management

Goal

The DOE's Clean Coal Technology program is developing cleaner, more efficient processes for converting coal into usable power. The combustion systems developed over the last decade, which will form the basis of the next-generation of power systems, will still generate large amounts of by-products from the combustion process owing to the natural heterogeneity of coal. Although the DOE's goal is to encourage beneficial use of these by-products, economic and technical limitations make it almost certain that large volumes of coal by-products will continue to be disposed of.

Benefits

- Design manual compiles available information on by-products from developing technologies for easy reference.
- Experience from the test sites provides regulators and managers with tools for decision making.
- Field data help calibrate physical and chemical models of by-product weathering and develop rule-of-thumb guidelines for facility design and by-product management.

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(cofunding)

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Midwest Grain Products Company
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Central Illinois Lighting Company
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